



UNIVERSITI PUTRA MALAYSIA

**DEVELOPMENT OF CHEMICALLY-DEFINED ARTIFICIAL DIET
FOR *MENOCHILUS SEXMACULATUS* FABR.
(COLEOPTERA: COCCINELLIDAE)**

MAKHRANI SARI GINTING

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**By
MAKHRANI SARI GINTING**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia in Fulfilment of the Requirement for the Degree of
Master of Agricultural Science**

July 2002



I dedicate this Thesis to my beloved parents

Dr. H. Mustafa Majmu and Hj. R. Nurlela Sitepu,

Brothers and sister, brother and sister in-law, nephew and nieces.

Thanks for giving me so much love and understanding.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Agricultural Science

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Supervisor : Prof. Dr. Mohd. Yusof Hussein

Faculty : Agriculture

Studies on the nutritional requirements of the ladybird *Menochilus sexmaculatus* were conducted with the objective to develop a chemically-defined artificial diet suitable for the growth and development of larvae and adults of *M. sexmaculatus*

The formulated diet was presented following the paraffin coating droplet technique. A diet of 1:3 dilution (1 part ingredients and 3 parts water) was used for feeding the first instar larvae, while 1:1 dilution was for later instars and adults.

Studies on yeast requirement showed that 7 g yeast hydrolysate improved survivorship, growth performance and longevity of *M. sexmaculatus*. As such this amount of yeast was mixed with 2 g casein hydrolysate, 5.5 g sucrose and 15 ml distilled water in a paraffin-vaseline

ratio of 2:1 to form the basic diet. In the study on amino acid requirements, 0.2 g of each of the 10 essential amino acids was added to the basic diet either together or separately. In a similar study on vitamin requirements, 0.2 g of different vitamins were added to the basic diet either together or separately. Results showed that *M. sexmaculatus* required methionine and histidine for the longest longevity, and pantothenic acid for the highest survivorship.

The best diet was obtained when methionine, histidine, thiamine (vitamin B1) and pantothenic acid (vitamin B5) were added into the diet. The performances of the ladybird were better when fed on this diet as compared with other diets developed in this study.

However, when compared to the ladybirds fed on live aphids, the best diet was not as satisfactory. Only 60% of the larvae successfully completed development to the adult stage compared to 95% on live aphid. Larvae fed on artificial diet took 15.6 days to complete their development, about five days longer than those fed on live aphids. The average pupal weight obtained from larvae fed on diet was 8.6 g. Pupae obtained from live aphids were heavier, about 11.1g. Nevertheless, the longevity of adults reared on artificial diet was not significantly different compared to those fed on live aphids. No eggs were obtained from the adults maintained on the artificial diet.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains Pertanian

**PEMBENTUKAN DIET TIRUAN BERKETENTUAN KIMIA
UNTUK *MENOCHILUS SEXMACULATUS* FABR.
(COLEOPTERA: COCCINELLIDAE)**

Oleh

MAKHRANI SARI GINTING

Julai 2002

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Kajian untuk menentukan keperluan nutrisi ladybird *Menochilus sexmaculatus* telah dijalankan dengan objektif untuk menghasilkan makanan tiruan berasaskan kimia yang sesuai dengan pertumbuhan dan perkembangan larva dan *M. sexmaculatus* yang dewasa.

Formula diet telah dihasilkan berdasarkan tehnik penyalutan paraffin. Satu cairan diet 1:3 (1 bahagian bahan-bahan dan 3 bahagian air) telah digunakan sebagai diet untuk larva instar pertama, manakala diet cairan 1:1 telah digunakan sebagai diet untuk instar selanjutnya dan untuk ladybird dewasa.

Kajian keperluan terhadap ragi telah menunjukkan 7 g ragi hydrolysate berjaya memperbaiki kemandirian, pencapaian tumbesaran dan

usia *M. sexmaculatus*. Oleh itu jumlah ragi ini dicampurkan 2 g casein hydrolysate, 5.5 g sukrosa dan 15 ml air suling di dalam paraffin-vaselin dengan nisbah 2:1 bagi menghasilkan diet asas. Dalam kajian keperluan asid amino, 0.2 g daripada setiap 10 asid amino penting telah dicampurkan ke dalam diet asas sama ada secara berasingan atau bercampuran. Dalam kajian yang serupa bagi keperluan vitamin, 0.2 g vitamin yang berlainan telah dicampurkan ke dalam diet asas sama ada secara bercampuran atau berasingan. Hasil kajian menunjukkan methionine dan histidine dapat meningkatkan umur *M. sexmaculatus*, manakala asid pantothenic dapat meningkatkan kemandirian *M. sexmaculatus*.

Diet yang terbaik telah dihasilkan apabila methionine, histidine, asid pantothenic (vitamin B5) dan thiamine (vitamin B1) dicampurkan ke dalam diet. Pencapaian ladybird menjadi lebih baik apabila diet ini digunakan berbanding dengan diet-diet lain yang dihasilkan dalam kajian ini.

Bagaimanapun, diet ini tidak menunjukkan sebarang peningkatan berbanding eksperimen yang menggunakan afid sebagai makanan. Hanya 60% larva berjaya ke peringkat dewasa jika dibandingkan dengan 95% bagi afid. Larva yang diuji dengan menggunakan makanan tiruan mengambil masa 15.6 hari untuk menjadi dewasa, iaitu lima hari lebih lambat daripada yang diuji dengan menggunakan afid. Purata berat kepompong yang terhasil daripada larva yang diberi makanan tiruan ialah 8.6 g. Kepompong yang terhasil dari afid mempunyai berat yang lebih, iaitu 11.1 g. Walau bagaimanapun, umur *M. sexmaculatus* dewasa yang ditenak dengan

makanan tiruan tidak mempunyai sebarang perbezaan jika dibandingkan dengan yang diberi makan dengan afid. Bagaimanapun, tiada telur dihasilkan oleh *M. sexmaculatus* dewasa yang diberi makan makanan tiruan.

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I certify that an examination Committee met on 3rd July 2002 to conduct the final examination of Makhrani Sari Ginting on her Master of Agricultural Science thesis entitled "Development of Chemically-Defined Artificial Diet for *Menochilus sexmaculatus* Fabr. (Coleoptera : Coccinellidae)" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION FORM

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



MAKHRANI SARI GINTING

Date: 16th August 2002

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ABBREVIATION

ANOVA	: Analysis of Variance
CRD	: Completely Randomised Design
DMRT	: Duncan Multiple Range Test
FC	: Food Combinations
L:D	: Light:Dark period
RH	: Relative Humidity
UPM	: Universiti Putra Malaysia

CHAPTER I

INTRODUCTION

Aphids are phytophagous insects that feed on a great variety of crops. *Aphis gossypii* Glover for example attacks cotton, kapok, sesamum and many others; *Aphis maidis* attacks maize, sugar cane and sorghum; *Toxoptera aurantii* Boyer attacks perennial crops such as cacao, cinchona, coffee, and tea (Kalshoven, 1981). Aphids are small, delicate, usually pear-shaped insects, with the largest species being not more than 6 mm long. They normally reproduce parthenogenetically, giving birth to living young females. Greenhouse experiments have shown that cotton aphid AG could complete 51 generations in a year, with each adult producing 85 young (Little, 1963). This ability of female aphids producing young parthenogenetically in a short period makes aphids one of the insects with a very high fecundity. They occur in dense populations, and thus can cause a great economic damage to the plants and considerable loss to the farmers. In Malaysia, they are very serious pest in chilli (Hussein, 1991). Besides causing damage owing to their feeding habits, they can also transmit virus diseases, cause mechanical damage to plants, injury through toxins, plant sap loss and reduced plant growth due to the sooty-mould that develops on the aphid-excreted honeydew (Rawat and Modi, 1969).

Aphids are normally held in check by natural factors, such as weather, natural enemies (predators and parasitoids). They can also be held in check through the efforts of man, by following the concept of insect pest management. Many tactics of plant protection can be applied; one of the tactics is Biological Control.

In the practise of biological control for aphids, the predaceous beetle, especially coccinellids are of great economic importance. The coccinellid *Menochilus sexmaculatus* Fabr is the most promising predator in maize and chilli in Malaysia (Hussein, 1991). Its high voracity and fecundity make it an efficient biological control agent (Parker & Singh, 1973). Hence efforts to mass rear *M. sexmaculatus* for biological control is imperative.

Problems

The culture of entomophagous insect is usually accomplished by rearing the insect on the living host, either natural or unnatural. Success of this type of programme is a matter of logistics and synchronisation of three life cycles: the plant, the phytophagous insect, and the entomophagous insect. The use of living or natural food is impractical, and uneconomical, if rearing for mass-release of the insects is planned. Hence research on artificial diets for the insects assumes importance.

In the rearing of biological control agents for mass release, three types of artificial diets are used. The first type only utilizes organic materials. The organic material may be the extract of the insects, or of meat, of chicken liver. The second type still utilizes organic materials, but mixed with chemical substances. The chemical substances are those thought to satisfy the nutritional requirements. The other type uses purely chemical materials. The former still depends on the existence of the natural foods, insects or other animals, while the latter can be manufactured in large quantities and at any time of the year, less laborious and hence more desirable.

Although considerable works have been done on improving the quality of artificial diets, researchers have not succeeded in formulating diets with adequate phagostimulatory properties and nutritional completeness. This is because most laboratories devise their own formulation of diets and procedures of insect rearing, and the information on the formulation and the procedure may not readily be available to other workers. Generally, chemically defined diets offer good clues in determining nutritional requirements (Nijima, 1993).

Therefore, research using specific chemically defined diet is hereby conducted to understand the nutritional requirements of the larvae and adults of *M. sexmaculatus*.